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3 Preliminary

3.1 General

The following series of articles provides a set of guidelines for development of type, size, and location (TS&L) plans. TS&L plans are of two types: (1) Preliminary Situation Plans for bridges, walls, and culverts that require final design and (2) Pipe Plat Plans for pipe culverts. Within the guidelines and throughout the development of TS&L plans it is important that the designer apply sound engineering judgment, including technical and economic analysis.

Additional information regarding preliminary design is also contained within BDM Chapter 2.

3.1.1 Policy overview

Within the Office of Bridges and Structures, the preliminary bridge design section develops the preliminary layouts for highway structures. For bridges, walls, culverts, and miscellaneous structures that require final design, the section assembles information and develops a preliminary situation plan sheet so that a designer in one of the final design sections can perform the structural design and develop final plans for a contract letting. For pipe culverts the section develops the layout in sufficient detail that the Office of Design can reference the information on their final road plans for a contract letting.

The development of all preliminary structure plans includes a number of tasks such as:

- Analyzing hydrology and hydraulics;
- Analyzing road geometrics;
- Determining the type, size, and location of structures;
- Developing a layout in the CADD system;
- Attending field reviews;
- Coordinating with other Iowa DOT offices, public entities, and outside agencies;
- Estimating cost alternatives;
- Obtaining flood plain permit approvals;
- Coordinating with other regulatory agencies; and
- Consideration of accelerated bridge construction (ABC).

3.1.2 Design information

The designer will need to access information from several sources to perform preliminary design, including the following:

- Plans for existing structures, including as-built plans, from Electronic Records Management System (ERMS);
- Bridge maintenance reports from ERMS and SIIMS;

- A new site survey from Office of Design;
- Soil boring information from the Office of Design;
- Aerial photographs from the Office of Design and/or web sites;
- Aerial agricultural photographs (drainage maps) from the Photogrammetry/Preliminary Survey Section in the Office of Design;
- Topographic maps from the Office of Bridges and Structures, the Office of Design and/or web sites; and
- Field exams.

Plans for existing structures will give a good indication of the site when an existing structure was built, widened, and/or extended, and comparison with a new survey will indicate any site changes that have occurred since previous construction.

The designer should make appropriate use of CADD to integrate support programs such as Geopak and GeoMedia when developing type, size, and location (TS&L) plans.

3.1.3 Definitions

Average low water is the water level expected during a normal season and may be defined by the vegetation line along a stream bank or by the base flow. The average low water can generally be represented by the water surface elevation at time of survey or can be defined as one foot above the average stream bed.

Bridge Backwater is caused by the encroachment of the road embankment onto the floodplain which constricts flood flows through the bridge opening.

Base Flood is the flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the “100-year flood.” The base flood is the national standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development.

Base Flood Elevation (BFE) is the computed elevation to which floodwater is anticipated to rise during the base flood. BFEs are shown on Flood Insurance Rate Maps (FIRMS) and on the flood profiles. The BFE is the regulatory requirement for the elevation or floodproofing of structures. The relationship between the BFE and a structure’s elevation determines the flood insurance premium.

Berm slope location table (BSLT) gives toe and top of berm information to aid the contractor in construction of the berm.

Bicycle lane or **bike lane** is a portion of a roadway which has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists.

Check scour is based on the occurrence of a 500-year or lesser flood used to ensure pile capacity and stability will not fail at the extreme scour event.

Detailed Flood Insurance Study (FIS) analysis of a community’s flood prone areas which determines the 100 year flood elevation and floodway for certain streams.

Design scour is based on the occurrence of a 200-year or lesser flood used to evaluate pile capacity and stability.

Electronic Reference Library (ERL) contains plans, specifications, and manuals and is available on the Iowa Department of Transportation’s web site.

Electronic Records Management System (ERMS) has been developed to enable electronic use and management of documents within the Iowa Department of Transportation. ERMS includes aerial

photographs, existing bridge plans, bridge inspection records, and other documents useful for preliminary bridge design.

Extreme highwater is the highest water level recorded for a particular location. Information can be obtained from USGS or Corps flood reports, when available.

Floodway is the portion of the floodplain that must be left unobstructed for the conveyance of the 100 year flood.

Flood Risk Reduction Project (FRRP) is typically defined as a Corps of Engineers designed flood protection levee system.

Freeboard is the vertical clearance measured between the bottom of the superstructure and the 50 year stage with the proposed bridge in place. Typically this clearance is measured in the middle of the channel at the downstream edge of bridge.

Grading surface is defined by key points on the Berm Slope Location Table [BDM 3.2.7.3.3].

Green book is the office term for the Office of Design's manual of Road Design Details.

Mean highwater (MHW) is a term used in the AASHTO Guide Specification for Vessel Collision Design of Highway Bridges and is defined by the Coast Guard as the average of the height of the diurnal (each day) high waters at a particular location measured over a period of 19 years.

Ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas [Code of the Federal Register 33 CFR Part 328.3].

Q100 is a flood that has a 1% statistical probability (chance) of being equaled or exceeded in any year.

Red book is the office term for the Office of Design's manual of Standard Road Plans.

Revetment is a relatively general term for a facing that supports an embankment. **Riprap** is a more specific term for the layer of various sized rocks or broken concrete used to protect a streambank from erosion. With respect to streambank protection the terms **revetment** and **riprap** usually are interchangeable. **Revetment Stone** is the quarry industry's product that may be used for streambank erosion protection.

Section 408 Approval is required from the Corps of Engineers for any project within 300 feet riverward or 500 feet landward of a Corps Flood Risk Reduction Project (FRRP).

Section Leader is the supervisor of the Office of Bridges and Structures preliminary bridge section, final design section, or consultant coordination section.

Shared use path is a bikeway physically separated from motorized vehicular traffic by an open space or a barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers, and other non-motorized users. See AASHTO's 1999 *Guide for the Development of Bicycle Facilities* [BDM 3.1.5.2].

Stage is the water surface elevation for a given discharge. Stage for the purpose of the hydraulic data block is the engineer's best estimate of the PROPOSED water surface elevation at the downstream toe of the road embankment.

Typical is the office term for a Road Design Detail.

3.1.4 Abbreviations and notation

3R, Resurfacing, Restoration, Rehabilitation; a series of terms that refers to a Federal Highway Administration highway project funding program

ADT, average daily traffic

AREMA, American Railway Engineering and Maintenance-of-Way Association

B0, event code for Office of Bridges and Structures concept

B1, event code for Office of Bridges and Structures layout

B2, event code for structural/hydraulic design plans to Office of Design

BTB, BTC, BTD, BTE, standard cross sections for pretensioned prestressed concrete bulb tee beams

BNSF, Burlington Northern Santa-Fe Railway

BSLT, berm slope location table

CCS, continuous concrete slab

CFR, Code of Federal Regulations

CLOMR, Conditional Letter of Map Revision issued by FEMA

CMP, corrugated metal pipe

CWPG, continuous welded plate girder

D₅₀, median revetment stone diameter

D0, event code for predesign concept

D2, event code for design field exam

DA, drainage area

ERL, Electronic Reference Library

ERMS, Electronic Records Management System

FEMA, Federal Emergency Management Agency

FHWA, Federal Highway Administration

FIS, Flood Insurance Study

HDPE, high density polyethylene

HEC-2, U.S. Army Corps of Engineers Hydrologic Engineering Center hydraulic analysis software

HEC-RAS, U.S. Army Corps of Engineers Hydrologic Engineering Center – River Analysis System hydraulic analysis software

IAC, Iowa Administrative Code

IFI, intermediate foundation improvement

IHRB, Iowa Highway Research Board

Iowa DNR, Iowa Department of Natural Resources

Iowa DOT, Iowa Department of Transportation

LOMR, Letter of Map Revision issued by FEMA

LT, left

M, distance between chord and arc at midpoint of horizontally curved bridge [BDM 3.2.6.3]

MCS, main-channel slope, a variable in USGS WRIR 03-4120

MSE, mechanically stabilized earth, generally associated with retaining walls

N or N-value, standard penetration test number of blows per foot (300 mm). N also may be given as SPT

NO, the Standard Penetration Test Number in the soils information chart.

n-coefficient, Manning's Coefficient [BDM 3.2.2.3]

NFIP, National Flood Insurance Program

NHS, National Highway System

NOAA, National Oceanic and Atmospheric Administration

NRCS, Natural Resources Conservation Service

PE, preliminary engineering

PEP, polyethylene pipe

POT, point on tangent

PPCB, pretensioned prestressed concrete beam

Q₂, Q₅₀, Q₁₀₀, Q₂₀₀, Q₅₀₀, estimated channel discharge at 2-, 50-, 100-, 200- or 500-year design flood frequency

RBLT, recoverable berm location table

RCB, reinforced concrete box, a type of culvert

RCP, reinforced concrete pipe

ROW, right of way

RSB, rolled steel beam

RSS, reinforced steepened slope

RT, right

SI&A, Structure Inventory and Appraisal

SIIMS, Structure Inventory and Inspection Management System

SUDAS, (Iowa) Statewide Urban Design and Specifications

TS&L, type, size, and location

UP or **UPRR**, Union Pacific Railroad

USGS, United States Geological Survey

WSPRO, water surface profile software developed by the U.S. Geological Survey

3.1.5 References

3.1.5.1 Direct

[IDOT PPM policy number] refers to a policy in the Iowa Department of Transportation *Policies and Procedures Manual*.

[IDOT SS article] refers to Iowa Department of Transportation *Standard Specifications for Highway and Bridge Construction, Series 2009* with article number. (Available on the Internet at: <http://www.iowadot.gov/erl/index.html>)

[OD DM article, table, or figure] refers to the Office of Design, Highway Division *Design Manual* with article, table, or figure number. (Available on the Internet at: <http://www.iowadot.gov/design/dmanual/manual.html?reload>)

[OD RDD sheet number] refers to the Office of Design, Highway Division “Road Design Details” with sheet number. Formerly the detail manual was referred to as the “green book.” (Available on the Internet at: <http://www.iowadot.gov/design/desdet.htm>)

[OD SRP sheet number] refers to an Office of Design, Highway Division “Standard Road Plan” with sheet number. Formerly the plan manual was referred to as the “red book.” (Available on the Internet at: <http://www.iowadot.gov/design/stdrdpln.htm>)

3.1.5.2 Indirect

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